Conclusions

Meeting on Interconnections

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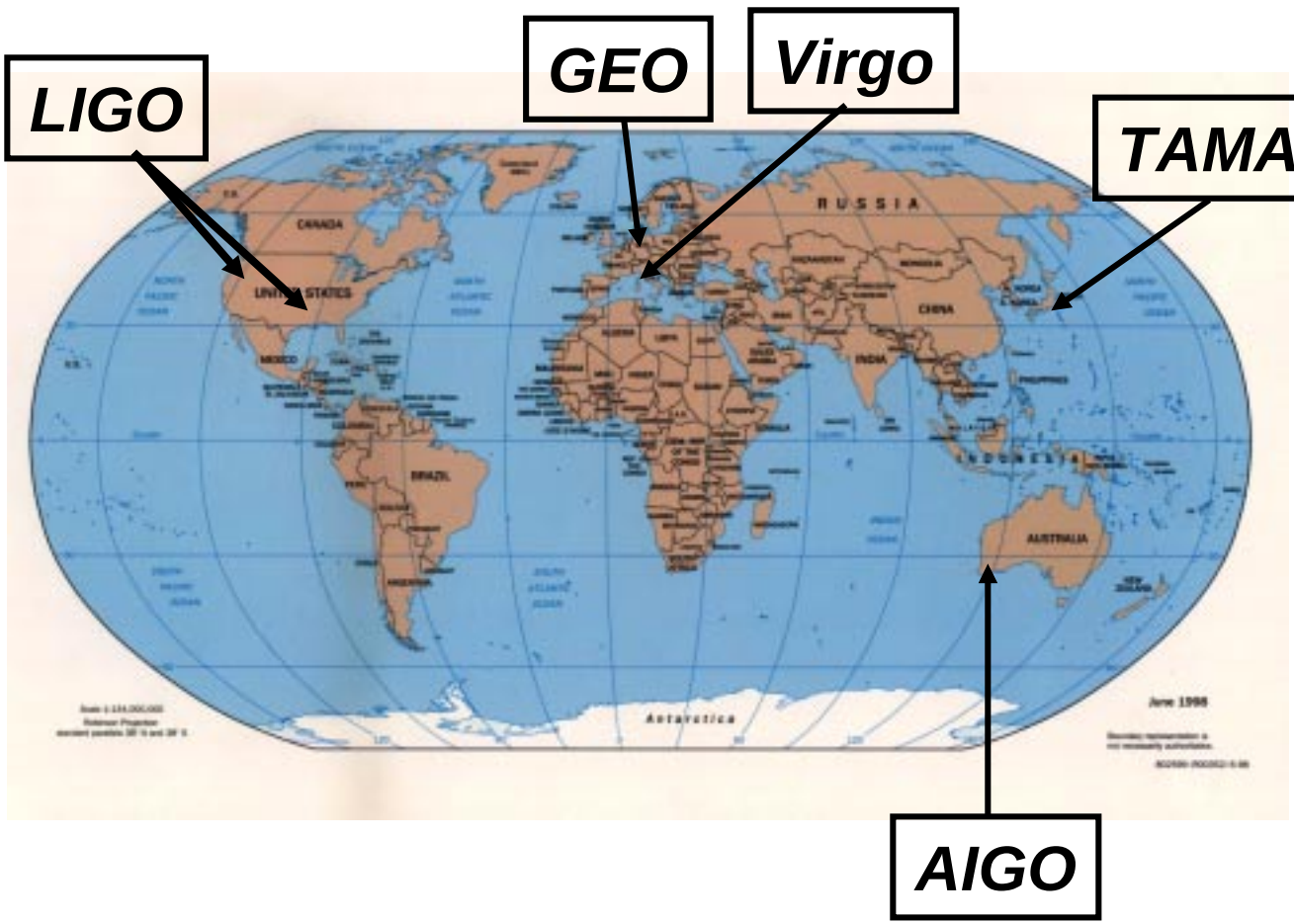
29 - Oct -02

Gravitational Wave
interconnections

- **Interconnections are made through *GWIC* "Gravitational Wave International Committee"**
  - » **Promotes the development of gravitational-wave detection as an astronomical tool, exploiting especially the potential for coincident detection of gravitational-waves and other fields (photons, cosmic-rays, neutrinos);**
  - » **GWIC's membership includes representatives of all the interferometer detector projects (ACIGA, GEO, LIGO, TAMA, and VIRGO), acoustic detector projects (ALLEGRO, AURIGA, EXPLORER, NAUTILUS, and NIOBE), and space-based detector projects (LISA).**

Interferometers
international network

Simultaneously detect signal (within msec)



detection confidence

locate the sources

decompose the polarization of gravitational waves

Gravitational Waves
interconnections

- **Common Data Format – "FRAMES" adopted by all interferometers. Bars are also adopting this format.**
- **GRID Computing coordination for gravitational wave community**
  - » **The grid distributed computing philosophy is well suited to a broad world-wide collaboration**
  - » **Interfaces to existing software systems and tests are underway**
- **Transoceanic Testbed -- LIGO and Virgo have agreed to implementation of a data exchange protocol based on grid technology**
  - » **Plan is to work together to migrate to grid toolkit to provide more robust, automated data exchanges around the clock**
  - » **Fits into the US-EU grid collaboration strategy**

World-wide
Gravitational Wave Network

The 5 "bar" detectors:

ALLEGRO (NSF- Baton Rouge),
AURIGA (INFN – LNL),
EXPLORER (INFN-CERN),
NAUTILUS (INFN- LNF),
NIOBE (ARC- Perth)

- **Exchanged and analyzed their 1997-2000 data under an agreement coordinated through GWIC (Cerdonio)**
  - » **Collaboratively searched for coincidental gravitational wave bursts in the Galaxy in control of false alarm/false dismissal probabilities to get, at > 95% confidence level, upper limits of < few/yr for violent events > 0.O2 M_{sun} converted into gravitational waves at the Galactic Center distance .**

World-wide
Gravitational Wave Network

- **The large interferometers are preparing for data exchange. There is an agreement between GEO and LIGO to exchange data for the early data runs, now underway. TAMA is also joining that exchange.**

- **Virgo and LIGO are exchanging environmental data and are preparing for gravitational data exchange in the future.**

- **LIGO has been an observer at *SNEWS* meetings, planning to eventually join supernovae early warning network.**

LIGO + GEO Interferometers

E7 Engineering Run

28 Dec 2001 - 14 Jan 2002 (402 hr)

Singles data

	All segments	Segments >15min
L1 locked	284hrs (71%)	249hrs (62%)
L1 clean	265hrs (61%)	231hrs (53%)
L1 longest clean segment: 3:58		
H1 locked	294hrs (72%)	231hrs (57%)
H1 clean	267hrs (62%)	206hrs (48%)
H1 longest clean segment: 4:04		
H2 locked	214hrs (53%)	157hrs (39%)
H2 clean	162hrs (38%)	125hrs (28%)
H2 longest clean segment: 7:24		

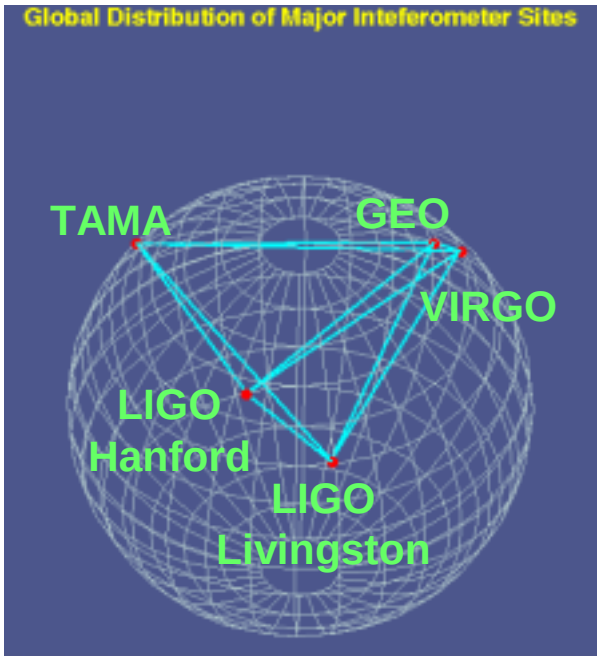
Coincidence Data

	All segments	Segments >15min
2X: H2, L1		
locked	160hrs (39%)	99hrs (24%)
clean	113hrs (26%)	70hrs (17%)
H2,L1 longest clean segment: 1:50		
3X : L1+H1+ H2		
locked	140hrs (35%)	72hrs (18%)
clean	93hrs (21%)	46hrs (11%)
L1+H1+ H2 : longest clean segment: 1:18		
4X: L1+H1+ H2 +GEO:	77 hrs (23 %)	26.1 hrs (7.81 %)
5X: ALLEGRO + …		

Conclusion: Large Duty Cycle is Attainable

Event Localization

array of detectors



SOURCE SOURCE

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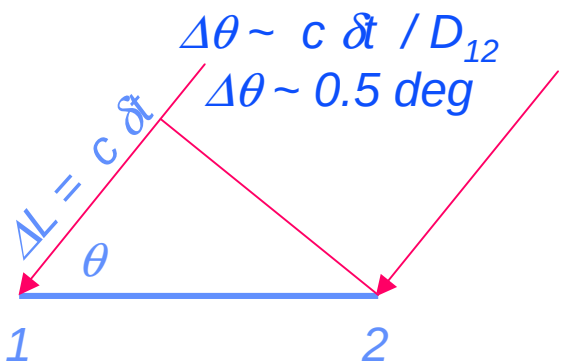

Neutrinos

SNEWS

- **SNEWS: A Neutrino Early Warning System for Galactic SNII -- Motivation**
  - » **SN1987A confirmed the core-collapse nature of SN II, but the neutrinos were not noticed until after the optical discovery.**
  - » **The current generation of neutrino experiments are both much larger and actively looking for SN neutrinos in real time.**
  - » **Neutrinos escape a new SN promptly while the first photons are not produced until the photospheric shock breakout hours later.**
  - » **Neutrinos can provide an early warning of a coming galactic SN II, and allow pointing of optical instruments to measure the rise of the "light curve."**

Neutrinos

SNEWS

- **SNEWS: A Neutrino Early Warning System for Galactic SNII -- 1st Goal: Eliminate False Rates**
  - » **the likelihood of two independent experiments experiencing a false alarm in coincidence is very small, therefore an automated alert can be issued with confidence.**
  - » **If each input experiment has a false alarm rate of < 1/week, the false coincidence rate will be << 1/century.**
  - » **A third or more experiment will further reduce false rate and allow triangulation to provide some pointing information.**

Neutrinos

SNEWS

- **SNEWS: A Neutrino Early Warning System for Galactic SNII -- 2nd Goal: Provide Pointing Information**
  - » **The reaction $\nu_x + e \rightarrow \nu_x + e$ provides directional information. Independently, at 10 kpc, it is estimated that Super-K could point to a ~5^0 cone on the sky, and SNO a ~20^0 cone.**
  - » **While hardly precise by photon astronomy standards, these solid angles are easily covered by large field of view instruments.**
  - » **Network Pointing Information: the statistics available to the current detectors suggests that the "triangulation" approach would be substantially less precise than the $\nu + e$ scattering, being mostly valuable as a confirmation rather than as a position refinement But, this itself is both a helpful and important cross-check.**

Neutrinos

SNEWS

- **SNEWS: A Neutrino Early Warning System for Galactic SNII -- 3rd Goal: Provide Early Warning**
  - » **Primary Detectors**
    - – **SuperK** **32 ktons H_20** → **4400 events @ 10 kpc**
    - – **LVD** **~ 1 kton Scintillator** → **250 events @ 10 kpc**
    - – **SNO** **~ 1 kton D_20** → **400 events @ 10 kpc**

    + Amanda. Borexino, KamLAND etc in the future.
  - » **Computers at Gran Sasso and at SuperK analyze coincidence exchange information. There is concern about security.**
  - » **High rate tests have been completed and validate coincidence efficiency and false rates.**
  - » **SNEWS can create a reliable alarm within ~ few hours to alert the astronomical community (human decision?)**

Conclusions

Interconnections Meeting

- **The gravitational wave experiments are encouraged to join SNEWS.**
  - » **They can provide “confirming” information and may have a “deeper” reach for supernovae in the longer term.**

- **The SNEWS Advisory Committee (leaders of the major experiments) should give the go ahead to SNEWS to become an official on-line SNII early warning system.**
  - » **This is likely to occur once SuperK turns back on in December.**